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Factors of priority setting in the government R&D investment

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정부 R&D 투자의 우선순위 설정의 요인들

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Abstract This article has reviewed some possible factors of priority setting in the government R&D investment, and also reviewed the roles of scientific community. Recently many development countries have planned more and more large-scale researches which require huge resources. Many large-scale researches have presented strikingly poor performance records in terms of efficiency. Nevertheless, more and more large-scale researches have been selected and executed. According to this article, some factors such as attracting attention of the media and the public, enhancing national prestige, raising the technological independence for economic growth were raised. As implications for policy, this article presented a necessity of strengthening the public control for priority setting of government R&D investment. And new procedures such as public discourse and National Assembly's in-depth deliberation were presented.

Key Words : government R&D investment, large-scale research, priority setting, scientific community, political process

요 약 본 논문은 정부 R&D 투자의 우선순위 설정에서 작동하는 요소들을 검토하고, 그 과정에서 과학자 공동체는 어떤 역할을 하는지 검토하였다. 최근 선진국들에서 대규모 연구들이 예상한 목표를 달성하지 못한 것으로 평가됨에도 불구하고, 더 많은 대규모 연구들이 계획되고 추진되고 있다. 이러한 현상은 자원의 한정성이라는 근본적 문제를 고려할 때, 역설적인 것이다. 우리나라에서 추진된 대규모 연구들을 살펴본 결과, 국민 및 미디어의 관심 등 정치적 자원의 확보, 국가의 위상 제고, 기술자립을 통한 경제적 효과 제고 등의 요인들이 작동하는 것을 확인하였다. 그리고 그 과정에서 과학자 공동체는 전문성과 합리성에 따라 연구 과제를 선택하는 합리적 전문가로서 행동하는 것뿐만 아니라 자기 분야의 대규모 연구 과제들이 채택되도록 노력하는 정치적 행위자로서 행동한다는 것을 확인하였다. 본 논문은 정부 R&D 투자의 우선순위 설정에서 대규모 연구에 대한 조급한 투자 결정을 줄이기 위해 공적 담론이나 국회의 심도 있는 심사 등의 새로운 절차가 필요함을 제시하였다.

주제어 : 정부 R&D 투자, 대규모 연구, 우선순위 설정, 과학자 공동체, 정치적 과정

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1. Introduction

The development of science and technology has been assumed as an important method for the growth of states. Thus many developed countries have invested huge resources to develop their scientific knowledge. In fact, advanced scientific knowledge has functioned as a breakthrough for national growth and prosperity[14]. As the science and technology development is advancing, the research and development(R&D) investment size also increases naturally. The size of resources to be allocated depends on both the degree of expected effects which the R&D investment would make and the amount of slack resources which the countries could afford to allocate.

Meanwhile generally it is said that the R&D investment is inherently an area of market failure. Since new R&D project is an inherently hypothesis in the ontological status, there is an inevitable uncertainty. That is, no one can exactly expect the success probability of any new R&D project. Therefore the investment to the new R&D project is a risky task. If the necessary resources for executing the new R&D project is too big, then private organizations(or individuals) could hesitate to invest resources to the uncertain project. Therefore, if the probability of failure is high and the size of resources to be allocated is big, then generally, governments would take the uncertain task. Of course, it do not mean that many private organizations also occasionally invest to their R&D projects expecting for long-term profit, but it has fundamentally limits.

Therefore the government R&D investment is important to promote overall scientific knowledge in any specific country. As Lasswell explained politics as a process of deciding “who gets what, when, and how”, the priority setting in the government R&D investment is essentially a political process. And as David Easton explained policy making as an “authoritative allocation of values”, the priority setting in the government R&D investment is an important policy making. Briefly speaking, the allocation of government R&D budget itself is a very important political process. In fact, many public R&D organizations, universities, and private organizations propose various R&D projects for getting government R&D investment[5]. But unfortunately, all countries have faced a common fundamental problem of the scarcity of resources. Thus various scientific groups have competed for getting more resources for their own field. Simply speaking, the process of priority setting of government R&D investment is typically a political process. In the process, each scientist group would emphasize the degree of expected effects which any new R&D project in their own S&T field would bring. We could often find some exaggerated claims about the effect of the new project[5]. In fact, it is a natural phenomenon that competing scientist groups have produced such exaggerated claims for getting more resources. If these exaggerated claims acquire some attention from the media and the public, it is likely to lead government's decision makers to select such R&D projects.

Meanwhile, in recent decades, the R&D investments have increased at an exponential rate. Overall investments in R&D range between 2% and 4% of GDP for OECD countries[8]. And many developed countries had planned more and more large-scale researches which require huge resources. Generally many countries expect that the large-scale R&D projects could bring some advantages, such as promoting economic growth, heightening national prestige, or technological independence, etc[4].

The Korean government has also planned many large-scale R&D projects in recent years. The large-scale R&D projects have taken an increasing portion of research budgets in the government R&D investment. The increasing of large-scale R&D projects has important implication to the S&T policies, especially related to the distribution of government S&T budget. In the context of the overall R&D budget

being limited, if the more budget is invested to the large-scale researches, then many small-scale researches would be squeezed.

Thus, in the context of the scarcity of resources, decision makers have fall in a dilemma situation which should set priority of investment between large-scale researches and many small-scale researches. The decision makers of government and congress should have consciousness about the possible risk, and should seek the accountability of making balanced development among various fields of S&T.

But, unfortunately many large-scale R&D projects have been evaluated to have failed getting expected outcomes. This means that any wrong selection of large-scale R&D projects would bring about wasting our scarce resources and squeezing other many necessary small-scale R&D projects[16]. Therefore many developed countries have tried to set up rational and systematic processes and prepare rigorous and valid criteria for priority setting in government R&D investment.

Then, would such rational processes and valid criteria be really workable in the priority setting in the government R&D investment? If the rational processes and valid criteria are really working, there is no problem. But the reality is not the case. The process of priority setting of government R&D investment is a more dynamic and political process. Thus the process has a sufficient value to be reviewed for more preparing rational and valid resources allocation.

This article would present some possible factors of priority setting in the government R&D investment. Firstly, this article would describe a phenomenon which large-scale researches increase more and more in number. Secondly, this article would review the roles of scientific community in the selection of government R&D projects, and theoretically compare two approaches as mechanisms of priority setting in the selection of government R&D projects. Thirdly, this article would present some political factors leading the priority setting of government R&D investment to a political process.

2. The Growth of Large-scale Researches in the Government R&D Investment

Generally almost all countries have pursued two goals of government R&D investment. One is to advance knowledge itself in the long-term. And the other is to promote economic development in the short-term[14]. But in fact, almost all countries have focused on promoting economic development, that is, utilizing the R&D projects as a breakthrough for economic growth. As knowledge-based economy has expanded, many developed countries have focused on the goal of promoting economic growth. Especially, since 1980s the phenomenon of globalization has expanded and deepened, many countries has emphasized the goal of promoting economic development in the government R&D investment[2,13,14]. In fact, according to the OECD report, “1% growth in public R&D leads to a 0.17% increase in total factor productivity in the long run”[8]. In this context, many developed countries had expanded competitively the total amount of the government R&D investment.

The Korean government also has emphasized the same policy priority in the government R&D investment. Since 1960s, the Korean government has focused on economic growth policies than any other policies. Especially the investment to the science and technology development is a major growth policy among many other policies. The growth of Korean overall R&D investment is evaluated as a dramatic one among OECD countries. Especially in 2013, the Korean overall R&D investment rate per GDP is 4.03%, which is secondly ranked following Israel(4.38%)[9].

〈Table 1〉 Gross Domestic Expenditure on R&D

Rank	States	2001	2011
1	Israel	4.58	4.38
2	Korea	2.47	4.03
3	Finland	3.32	3.78
4	Japan	3.07	3.39
5	Sweden	4.13	3.37
6	Iceland (2001, 2009)	2.95	3.11
7	Denmark	2.39	3.09
8	Germany	2.47	2.88
9	Switzerland (2000, 2008)	2.47	2.87
10	United States	2.72	2.77
11	Austria	2.05	2.75
OECD Average		2.24	2.37

Source : OECD Science, Technology & Industry Scoreboard 2013.

At the same time many countries have planned more and more large-scale researches which require huge resources. Generally many countries expect that the large-scale researches could bring a big opportunity for economic growth. But many large-scale researches have presented strikingly poor performance records in terms of efficiency. Nevertheless, more and more large-scale researches have been selected and executed. Flyvbjerg et al. explained this phenomenon as a paradoxical one, which means that more and more large-scale projects(so called as 'megaprojects') are built despite the poor performance records. Flyvbjerg et al. explained that the paradoxical phenomenon has been caused by inadequate deliberation about potential risk and lack of accountability in the R&D project selection[4].

Why, then, these problems had occurred? According to many researchers, decision makers of each country have selected large-scale researches with expectation that "big decision could bring big return." But in the light of common sense, big decision could also bring 'big risk'[4]. If the size of the research is bigger, then the controllability of the research execution is decreasing. If the size of R&D projects is bigger, then stake-holders such as, related scientists, related politicians, and related interest groups are increase, and thus the more environmental factors could interfere in the projects process. Then the controllability of the researches are decreasing naturally. If the controllability of research conducting would be decreasing, then the possibility of failure would be increasing.

The more important is that if the vast resources is invested to the large-scale researches, then many small-scale researches could be squeezed[16]. In the context of scarcity of resources, it is natural that selecting any large-scale research cause cutting back other small-scale researches. Thus as mentioned in front, the decision makers should think about the potential opportunity cost of losing many necessary small-scale researches. Thus decision makers of government and congress should have consciousness about the possible risk, and should seek the accountability of making balanced development among various fields of S&T.

According to Ratchard and Colombo, "the most likely supporters of large-scale researches are the scientists working in the affected field of research. Proposals for new large-scale researches originate with the scientists, usually formal or informal groups outside governments. They address the most exciting scientific challenges in the particular field"[12]. Then, what is the role of scientific community in the priority setting of government R&D investment?

3. The Role of Scientific Community in the Priority Setting of the Government R&D Investment

Generally speaking, as the size of scientific community grows, the size of demanding resources also grows. But the size of resources to be allocated would be limited to the extent that our society could afford. But nearly all countries have the political orientation for more quick economic growth and development. For this political orientation, many developed countries have planned and selected the government R&D projects through the collaboration

with scientific community.

Then, what's the role of scientific community in the priority setting of the government R&D investment? And what mechanisms have been worked in the priority setting of the government R&D investment? The mechanisms could be narrowed down two approaches of the selection of government R&D projects. One is giving the selection authority to the scientific community. This approach is based on the expertise and autonomy of scientific community as an important reference system. And the expertise and autonomy of scientific community in advancing and developing scientific knowledge is recommended as a necessary condition. The other is emphasizing the societal control in the priority setting of the government R&D investment. Thus this approach is not to give the selection authority to the scientist community. On the contrary, the government should have the overall power of in the selection process. Nevertheless, this approach does not mean to deny the expertise of the scientific community. But there is any limitation of the autonomy of scientific communities. Considering the situation that public resources to be invested is tremendous, the government and whole society should engage in the selection of the government R&D projects.

3.1 The Autonomy of Scientific Community in the Selection of Government R&D Projects

Generally, in the selection of R&D projects, a high degree of expertise with rigorous professional norms is required. Due to investing tremendous public resources, the selection of government R&D projects needs prudent and deliberate decision making system. Thus it has been accepted to give the selection authority of government R&D projects to scientific community. In the United Kingdom, in the early years of the 20th century, the Haldane Principle has been recommended. The Haldane Principle is the idea that decisions about what to spend research funds on should be made by researchers rather than politicians. According to the Haldane Principle, researchers should determine detailed priorities while government sets over-arching research strategies[15]. Thus the Haldane Principle represents the necessity of autonomy of scientific community.

The Haldane Principle is similar to the idea of 'the Republic of Science', as Polanyi and the Mertonian group explained. According to Polanyi and the Mertonian group, 'the Republic of Science' has the rigorous self-regulation mechanism, that is rigorous professional norms[10,11] The Mertonian described four sets of institutional imperatives which are composed of the ethos of modern science: "Communism, Universalism, Disinterestedness, and Organized Skepticism." These four terms could be arranged to form CUDOS. In the rigorous professional norms of self-regulation, scientists are pursuing the objective truth and advancing scientific knowledge itself[10].

Micheal Polanyi argued that "the pursuit of science can be organized .... in no other manner than by granting complete independence to all mature scientists. They will then distribute themselves over the whole field of possible discoveries, each applying his own special ability to the task that appears most profitable to him. The function of public authorities is not to plan research, but only provide opportunities its pursuit. All they have to do is provide facilities to every good scientist to follow his own interest in science"[11]. In this context, policy-makers have generally deferred to the scientific community in setting priority of government R&D projects, at least until ethical or safety issues arise. This has enabled scientists to deny that they are an organized political interest[1].

In this approach, Greenberg argued that the scientific community could be seen as bound together by a twofold ideology. Firstly, scientific community has a desire for society's support, but would not to be governed by society. Secondly, scientific community

has a desire for existing as loosely organized entity, that is, meritocratic anarchy, in which various organizations of scientists bear little relation to the realities of power[6,7].

After all, this approach is based on the public trust to the scientific community. Generally the public had given considerable trust to the overall scientific community. The public has a belief that the decision making what to spend research funds on is neutral, rational, and non-political processes.

3.2 The Necessity of Public Control in the Selection of Government R&D Projects

The second approach is not to give the selection authority to the scientific community. On the contrary, the government and the public should engage and control the selection process of government R&D projects. Since the selection of government R&D projects is very important, the selection authority should be in the control of government and the whole society. John Desmond Bernal had argued that "science was too powerful to be left to scientists"[1].

In this context, Daniel S. Greenberg argued that "the public have a right to know on what basis research funding is distributed both nationally and regionally; the rationale for funding decisions should be transparent and rigorous"[6,7]. For acquiring transparent and rigorous rationale, Daniel S. Greenberg argued that "the public should know this, know that the politics of science is like and how it came to be like that. The politics of science ought to be made as visible as other forms of politics, and making such matters visible was itself a virtuous political act"[6,7].

In a similar context, David Dickson also argued about the political relationships affecting science funding. David Dickson explained that "decisions about science are becoming concentrated in a closed circle of corporate, banking, and military leaders and that scientific enterprise is being steadily removed from public decision-making"[3].

Since 1970s, in the United Kingdom, an alternative approach to the Haldane Principle had emerged. The alternative approach is the Customer-Contractor Principle. In 1972, Victor Rothschild had provided this alternative principle in his report *'A Framework for Government Research and Developmen'*[15]. In this report, he stated that "the concepts of scientific independence used in the Haldane Report are not relevant to contemporary discussion of government research"[15]. Rothschild's alternative principle had made the government departments the 'customer' who commissioned 'contractors', scientific community - in British, the Research Councils and universities - to do research[15]. This approach has some reasonable ground that scientists cannot decide what the needs of the nation are, and their priorities, as those responsible for ensuring those needs are met.

The Customer-Contractor Principle had brought about a greater scrutiny of the activities of scientists, a need for scientists to justify more clearly their demands upon public resources, and a generally tougher financial environment. The British government involvement in science research priorities setting had continued to grow throughout the 1970s and 1980s, especially in the Thatcher administration[15].

Many large-scale researches have been propelled by the two approaches, the Haldane Principle as a bottom-up approach and the Customer-Contractor Principle as a top-down approach. There are inevitable tensions between the Haldane Principle and the Customer-Contractor Principle. Thus decision makers should make appropriate decision between priority setting driven by government and by scientific community. But this task is very difficult, because each principle has a respective plausible logic. Simply speaking, it can be said a kind of dilemma, thus decision makers could not make easily appropriate decision between guaranteeing the autonomy of scientific community and taking the public control in the priority setting of government R&D investment.

4. The Rationales of Selecting Large-scale Researches

Quite naturally, large-scale researches consume substantial fraction of all government expenditures on research[1]. A decision making to allocate public resources is fundamentally a political activity. And the political nature of science has in essence no difference from other types of political activities. Daniel S. Greenberg argued that "big science had big budget, and like other big-budgeted policies, it had its vested interests, its lobbying apparatus, its pork, its public-relations exercises"[6,7].

As mentioned earlier, if the size of the research is bigger, then the controllability of the research execution is decreasing. If the controllability of research conducting would be decreasing, then the possibility of failure would be increasing. Nevertheless Flyvbjerg et al. explained the paradixical phenomenon that large-scale researches could not get expected performance, more and more large-scale researches have planned[4]. Then, what's the rationale for propelling large-scale researches?

According to Ratchard and Colombo, there are many causes why government support large-scale researches[12]. First, national security consideration has been an important source of large-scale researches. Many developed countries have invested tremendous resources in the defense research field[12]. Generally almost all countries, the government R&D projects of the defense field are dealt with state secret affairs. Thus the information about the size of the defense R&D projects has been confidential affairs. But occasionally some countries boasted the success of new weapons development, we could acquire the size of the invested budget. The sizes are generally tremendous ones. In fact, so many large-scale researches in the defence fields have been executed in developed countries from 1950s, and it had been referred as 'big science'[7]. Especially during the Cold War, the military race had accelerated the investment to the defense field of R&D projects.

Second, the policy orientation of promoting economic growth has been important rationale for seeking large-scale researches[12]. Generally it is assumed that the massive investment to the science and technology is the core factor of growth and prosperity of developed countries. Thus many developing countries have planned massive investment to the science and technology for catch-up the developed countries.

Third, raising national prestige is also an important source for picking large-scale researches. Especially, space development research is a representative case[12]. The success of launching a space rocket will be a very important criterion indicating to become a developed country, that is, to become a member of the 'Space Club.' Since space development research consumes tremendous resources, there are many pros and cons about the validity to do the space development research. But if any national leader would like to upgrade the national prestige in the global community, then he would like to persuade the public to accept the necessity of space development research. Occasionally, large-scale researches such as space development research is utilized as a policy symbol by political leaders.

Fourth, interestingly, 'scientific fashions' could explain the rush to fund certain fields which happen to be championed by the media[12]. Any strong fad about any specific research field sometimes can outweigh any rational scientific justification for the priority setting. In Korea, stem cell research is a representative case. According to Ratchard and Colombo, similarly, changes in fashion can suddenly alter previously accepted notions of utility of large-scale research[12].

Considering these rationales, it could be said that the selection process of large-scale researches is not a neutral and rational process, but is a factional and political process. Then, what is the situation in Korea?

5. The Rationales of Korean Cases and Some Implications

Since 1990s, the Korean government has expanded dramatically the total amount of the government R&D investment. Especially in the years of 2000s, the Korean government has planned more and more large-scale researches. Like many other developed countries, the Korean government has selected many large-scale researches not only through rational process, but also through political process. Several political rationales could be raised. These political rationales also could be found in many other developed countries.

First, political leaders has utilized large-scale researches for attracting attention of the media and the public. Naturally political leaders are pursuing political resources. In the 2007 Korean Presidential Campaign, the candidate Lee MyungBak had proposed 'the National Science and Business Belt.' In effect, the proposal of 'the National Science and Business Belt' has extracted the attention of the media and the public. And that large-scale research proposal had contributed to the win of the candidate Lee MyungBak in the 2007 Presidential Campaign. And after the campaign, several local governments had competed for inviting the project to their provinces.

Second, enhancing national prestige is a very important rationale in Korea. The Korean government has emphasized the policy orientation of entering into the group of developed countries as soon as possible. Therefore the policy orientation of the Korean government has been focused on establishing developmental policies for entering in the group of developed countries. The Korea Space Launch Vehicle(KSLV), so-called 'the Naro Project' is the typical example. The total cost of the Naro Project was over 500 billion won, raising concerns among the Korean populace about the validity of the Naro Project. But the Naro Project has continuously been progressed despite the failure of twice in 2009 and 2010.

Third, the logic of technological independence is also an important rationale for the Korean government. The Korean government has always emphasized the logic of technological independence in all industrial areas. The logic of technological independence could be directly linked to the logic of economic growth. And the technological independence has been emphasized in the national defense area specially, because the technological independence of the national defense technology could ensure the national security. The project of Korean Utility Helicopter(KUH), so-called 'the Surion Project', is the typical example. In June 2006, the cost of KUH project had been estimated 1.3 trillion won.

These rationales represent that the selection process of large-scale researches is not only a neutral and rational process, but also a typical political process. And these political rationales showed the possibility of paradoxical phenomenon which more and more large-scale researches are built despite the poor performance records. Thus the important thing is how to ensure the accountability of decision making in the priority setting in the government R&D investment. The accountability of decision making is accomplished not only by securing better information and better methods for decisions, but also arranging institutional apparatus.

Interestingly, all large-scale researches had started with very high possibility of success. The interested scientists to any large-scale researches are likely to exaggerate the possibility of success and the spillover effect for economic growth or national prestige. There may be initial funding for study to confirm feasibility. The crucial point to the decision to go further is the cost estimate and selection of the site and contractor. Low estimates of construction costs are not uncommon. This approach is sometimes referred to as 'the camel's nose under the tent' strategy. This strategy means that though any large-scale research was selected with

small resources at first, the research would become a larger research. The government could not abandon the research because of the sunk cost. The excessive, and sometimes partisan, optimism of scientific community may carry initial approval of a particular large-scale research.

But according to Ratchford and Colombo, "an accumulation of cost overruns and construction delays soon becomes a boomerang which, in turn, casts doubt on the credibility of future projects, even in other areas of science." This problem is compounded by the fact that large-scale researches, once budgeted, are difficult to stop[12].

In contrast to general thought, scientists as a political actors have their own various nested interests. such as direct economic interests, individual honor as a scientist, professional clout in the science area, etc. According to Ratchford and Colombo, in USA, "many scientists have moved beyond the walls of the scientific community and the affected research agencies in supporting specific large-scale researches"[12]. It could be said that it is not much better in Korea.

The priority setting in the government R&D investment is not only a rational process operated by 'the Republic of Science', which is premised as to be operated on the logic of self-regulation by scientist community. But also the process is a political process in which various coalitions of scientists compete for getting more resources for their own science field. Naturally the scientific community composed of people has equivocal nature. Scientists are just private persons who seek self-interest maximizing. And they are also regulated by norms such as CUDOS shared by the Republic of Science. In this respect, government should make appropriate decision between guaranteeing autonomy of scientific community and taking public control about the priority setting in the government R&D investment. This task is not at all a simple task. The possible solution is establishing deliberate and valid procedure of the public discourse for guaranteeing transparent decision making about large-scale researches.

6. The Practical and Theoretical Implication

Some practical and theoretical implications could be raised. In terms of practical aspect, the most important thing is necessary to strengthen the public control for priority setting of government R&D investment. Strengthening the transparency of the process of priority setting is the most important thing. For this purpose, it is necessary to build a more public procedure than before. The possible public procedure could be considered at the two phases of governmental policy making cycle.

The first phase is a public discourse for the large-scale researches. The public discourse could be performed through various ways of debating between various scientific groups. Of course, all interested citizens and scientific NGOs could participate in the debates. Through these like public discourses, our society could learn possible advantages and disadvantages related large-scale researches. This public discourse could enhance the transparency and build social consensus.

The second phase is an additional in-depth deliberation in the National Assembly. In fact, the Korean government has aleady executed the Pre-feasibility Study as a tool of deliberation. But the Pre-feasibility Study is operated by the executive branch, and it is based on the way of peer-review. Therefore it has a limitation which could not function as veto points to stop any exaggerated proposal. A new in-depth deliberation of the National Assembly could function as a strong veto point, which could stop any risky large-scale researches. New procedures of public discourse and National Assembly's deliberation could reduce the premature decision and check the possible pitfalls of the large-scale researches.

Meanwhile, in terms of theoretical aspect, this article has a theoretical implication. In Korea, most of literatures about government R&D investment have focused on the performance review under the presumption that the priority setting in the government R&D investment had followed the rational decision making. But because the priority setting in the government R&D investment is inherently a process of resource allocation in the context of scarcity of resources, we should accept it as a political process.

Of course, some researches raised the possibility that the priority setting of government R&D investment could be political nature. But that researches did not raised any specific factors of the political nature. This article, though stuck at the rudimentary level about this theme, focused the possible factors that lead the priority setting of government R&D investment to some political process. As repeatedly presented above, this article assumed that the scientific community has equivocal nature. One is a disinterested neutral group regulated by CUDOS norms, the other is just a interest group seeking self-interest maximizing. Recently, in Korean context, there has been growing concerns about the strong political power of scientific communities in the government R&D investment. Especially, there are increasingly growing concerns about the cozy relations between political leaders and famous scientists. Dr. Hwang Woo-Suk scandal was the representative case, in which several departments of central government and several local governments had put vast resources into the stem cell research project. In this context, this article propose that we should aware of the priority setting government R&D investment as a typical political process.

This article has a limit that more detailed empirical research lacks. Hereafter, based on this article, the author hope the more empirical case study and the more valid research about the priority setting of government R&D investment.

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